# agricultural research

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## Enduring Opponents

Since the dawn of time, insects and humans have engaged in combat. We have swatted, stepped on, squashed, and sprayed insects—but still they endure.

Their endurance rests upon their reproductive capacity which is staggering to contemplate. If all the progeny of only one pair of house flies lived to maturity and reproduced, the entire earth would be covered to a depth of 47 feet within 5 months. Fortunately, no insect ever has the opportunity to multiply to its limit. Like most living things, insects are susceptible to bacterial and fungus diseases, along with the other perils of life.

Rather than mankind, the most successful enemies of insects are other insects. Throughout their lives—from egg to death—most insects are surrounded by other insects trying to eat them, lay eggs in or on them, or to seize and carry them off as food for their own young.

Insects have survived for 250 million years endowed with marvelous mechanisms which should permit them to survive for many more. We know that no species of insects has disappeared from the earth because of human activities, as have the dodo, the passenger pigeon, and several other animals.

We benefit from insects in endless ways. Thousands of insect species assist in pollinating our entire flora of insect-pollinated plants. We could exist without these pollinating insects; tomatoes and potatoes for example, are wind pollinated, but it would be difficult to find substitutes for such insect-pollinated crops as clover, alfalfa, and fruit. Without insects, a variety of crops ranging from almonds to zucchini would yield considerably less. And springtime would be bleak without gayly colored flowers.

Bees accomplish most of this work with some help from wasps, butterflies and moths, flies, beetles, and even minute thrips.

Some insects improve our soil by providing holes for air penetration. Others hasten the decay of animal bodies. Thus insects participate in the endless cycles that involve all life.

Of the approximately 1,500,000 insects that entomologists have managed to describe and name, only 10,000 are considered harmful to humans and their food and fiber supply. It is upon these "harmful" insects that agricultural research must concentrate—seeking techniques that will hold only these enduring insects at bay.—*M.M.M.*

**COVER:** Cotton under harvest on a large test plot in the Salt River Valley near Phoenix, Ariz. The plot has been treated with growth regulators to prevent the formation of late-season bolls, harboring places for the destructive pink bollworm (0176X18–34A). Article begins on page 8.


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**Earl L. Butz, Secretary**
**U.S. Department of Agriculture**

**Talcott W. Edminster, Administrator**
**Agricultural Research Service**

*In rangeland tests of the new plant recording technique, species within a rectangular frame are identified by Dr. Houston and indexed in a "tally" box by botanist Marilyn J. Samuel (0974X1535–17).*

# Precision on the range

SCIENTISTS have developed a new and improved technique for measuring the increase or decrease of herbaceous plants on rangeland. It provides better and more efficient use of the very old "frequency of occurrence method," because the new equipment permits fast and accurate tally of a large number of observations. Now scientists can obtain detailed and statistically sound information on vegetation-soil relationships, plant community relationships, and responses of species to herbicides, season and intensity of grazing, seasonal distribution of precipitation, and nitrogen fertilization.

Almost any sampling method on rangeland—weight, cover, intercept, or

density—can detect changes in a few dominant species, but they are inadequate if the number of species is large. The new system goes beyond this. It produces data on large numbers of dominant, subdominant, and moderately rare species.

The system was developed by range scientists Donald N. Hyder and Walter R. Houston, and Colorado State University student assistant Jeff B. Burwell at the Crops Research Laboratory (Colorado State University, Fort Collins, CO 80521).

Two people are required to employ the frequency sampling technique. One person places a metal rectangular frame on the plot to be inspected. He then calls out to an assistant the names of all species inside the frame, which is called a quadrat, using four-letter abbreviations. The assistant uses a pistol-shaped dispenser to drop a small steel ball for each species called out into a box of vertical tubes, each labeled for a different species.

The tally or recording box contains 6 rows of 16 tubes for simultaneously accumulating the frequency of as many as 96 species. Each tube can hold 25 balls to represent 25 sightings of a species. The box is portable and one person can easily carry it.

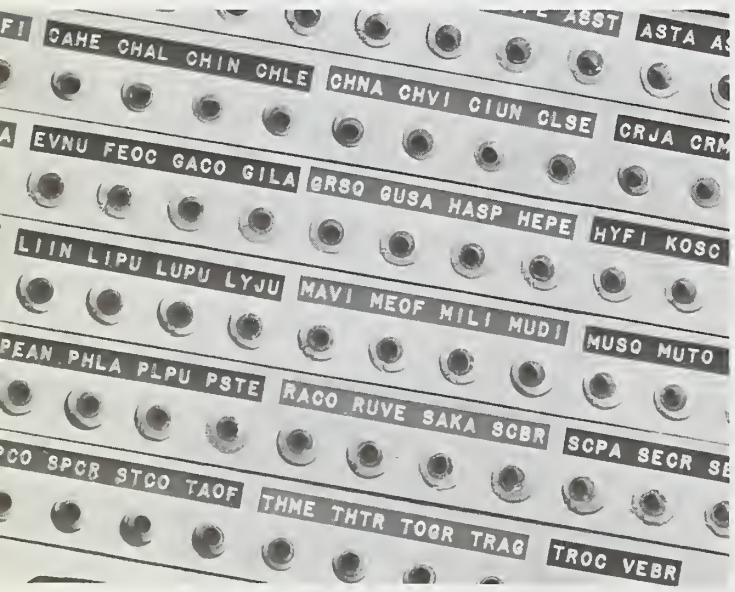
The previous procedure of tallying species by penciling dots and lines on paper slows field observation, is highly subject to error, requires the handling of vast amounts of paper, and takes a great amount of time to compile data. Electronic or mechanical tally equipment on the market would cost much more, be less effective, and require heavier equipment.

With the new system, scientists work an area 75 by 90 feet to take readings from each stand of vegetation. This area, called a macroplot, is marked off with 10 lines or transects. Each transect is read at 25 different places to yield 250 observations for each macroplot.

At the end of each transect, the total sightings of each species is measured with a graduated scale that reads directly in percent frequency of occurrence.

For example, 25 balls or sightings means that the species occurs 100 percent of the time. These readings are recorded on tally sheets in a matter of seconds. A two-man team can record data on each macroplot in about 2 hours.

Material for the pistol and tally box costs less than $25 and can be constructed by an experienced carpenter in about 2 days.—*D. H. S.*




***Above:*** *Top of "tally" box has holes for steel balls and abbreviations for 96 species of plants (0974X1535–34).*

***Right:*** *Ms. Samuel holds the pistol-like dispenser that drops steel balls into the "tally" box to record the frequency of occurrence of plant species within a specific area (0974X1535–23).*

# Rx for Erodible Southern Soils

NO-TILLAGE FARMING can give good control of erosion on the intensively cropped upland soils of the South.

Previous research has shown no-tillage farming to also have the advantages of increased moisture for crop growth, decreased compacting of the soil, time and labor savings, and increased crop yields.

The erosion of farmland is a serious and growing problem for various reasons. Large single crops like soybeans are often farmed on irregular and sometimes steeply sloping land with modern multirow farm equipment that is not well adapted to erosion control practices such as contour tillage. Much pasture land has been converted to clean-tilled fields and plowed without regard to slopes. Consequently, erosion of good farmland is on the increase.

No-tillage farming would allow farmers to use multirow equipment and at the same time reduce the movement of soil from their fields. Such a change in farming methods would save valuable topsoil, avoid the silting of streams, rivers, and lakes, and cut down the pollution of those waters.

A research team headed by ARS agricultural engineer Keith C. McGregor, USDA Sedimentation Laboratory (P.O. Box 1157, Oxford, MS 38655) found in a 3-year study that no-tillage methods of cropping greatly reduced soil losses compared to conventional tilling.

In the case of soybeans, seven times more soil was lost through erosion from conventionally tilled plots than from the no-tillage plots. Also, no-tillage has a beneficial cumulative effect: as surface matting and mulch increase, soil erosion continues to decline, and the least amount of erosion recorded from no-tillage plots was in the third year of the test. On the other hand, erosion from conventionally tilled land was highest during the third year. Less than 0.7 tons of soil per acre was lost from no-tillage plots during the third year of the test while 9.0 tons were lost from an acre of conventionally tilled land.

Both no-tillage and conventional tillage plots had identical 5 percent slopes. The researchers collected runoff from the plots and measured the soil loss.

In the no-tillage method, the scientists planted crops in a 2- to 3-inch-wide seedbed cut by a fluted coulter in rows 40 inches apart. They applied fertilizer in a slot made by a double disc opener 3 inches from the seedbed. A preemergence and one or more postemergence applications of herbicide controlled grass and weeds.

Conventional tillage included moldboard plowing, seedbed preparation, and followup cultivation to control grass and weeds. The crops planted in the test were soybeans, wheat, and corn. In general, yields for both tillage methods were about the same. However, weather conditions that delayed postemergence applications of herbicides caused lower yields on some no-tillage plots.

The researchers noted that rainstorms during June and July, months of early plant growth, are particularly devastating to conventionally tilled land. A single storm during the midde of June caused 46 percent of 1 year's erosion in conventionally tilled plots.

The silty clay loam soils where the test was made are typical of loessial soils throughout the southern Mississippi Valley silty uplands. These soils are highly erodible—thus the benefits of no-tillage or reduced tillage would be widespread if these practices were adopted in the upland South.—*B. D. C.*

# Rice bread for special diets

A BREAD made from rice flour would make life a little easier for people who must restrict their diets for reasons of health. Patients with hypertension, nephritis (inflamed kidneys) and digestive difficulties, for example, would benefit from diets that include rice bread because rice contains low levels of sodium, protein, fat and fiber, and high amounts of easily digested carbohydrates.

Moreover, celiac victims (people whose small intestines react to certain proteins in wheat, causing pain and malabsorption of nutrients) can safely eat rice bread because rice does not contain these particular proteins. Thus rice bread would provide these people with another food, adding more variety to their diets.

The major problem that had to be overcome before rice bread could become a reality was finding a suitable ingredient that would act as gluten does in wheat bread. Gluten traps the leavening gases produced by the yeast during fermentation, thereby allowing the dough to rise. Chemically leavened rice bread recipes are available, but these breads do not have the texture or taste normally associated with yeast-leavened breads.

Researchers at the Western Regional Research Center (800 Buchanan Street, Berkeley, CA 94710) found that a gum, hydroxypropyl methylcellulose, served as an effective substitute for gluten. Previous work at the Center and in other laboratories indicated that methylcellulose would work in other nongluten breads, such as sorghum breads and starch bread (containing no protein).

*Mrs. Nishita measures and weighs ingredients prior to mixing dough for rice bread. Vegetable oil—the ingredient being weighed here—is the preferred lipid for maximum bread performance (1075X2088–2A).*

*Mrs. Nishita and Mrs. Bean prepare bread samples for a taste test. The final product is graded for grain, texture, and general eating quality. In appearance and flavor, rice bread resembles wheat bread enough that the uninformed probably could not distinguish between them (1075X2089–35).*

Methylcellulose is already approved as an acceptable food ingredient.

Food technologist Kazuko D. Nishita, as part of her work for a M.S. degree, created a rice bread recipe using yeast and methylcellulose. This yeast-leavened rice bread has color, flavor, and texture similar to conventional breads.

Mrs. Nishita, working with ARS food technologists Robert L. Roberts and Maura M. Bean, and University of California food chemist Barbara M. Kennedy, found that refined vegetable oils were more effective than fat for improving the overall quality of the breads. Hydrogenated shortening and dough conditioners normally used in wheat breads to improve quality had the opposite effect on rice breads. Because high levels of oil can be used, caloric content can be increased, making the bread useful for people on certain restricted diets, such as modified protein diets.

Studies presently underway are aimed at identifying rice varieties that have good baking properties and developing a mix suitable for preparing rice bread at home.— *D. H. S.*



# New lamb meat products

THE successful market introduction of new fabricated lamb steaks manufactured from nonprimal cuts—like briskets, necks, and trimmings—may halt, and hopefully reverse, the longtime downward trend in domestic per capita consumption of lamb meat. For example, per capita consumption of lamb was 4.8 pounds in 1960. In 1975, it was 2.0 pounds.

Nonprimal cuts have always been a millstone to meat purveyors. On the other hand, the prime cuts—legs, chops, and racks—historically, and even today are in short supply and highly priced.

Several years ago, Pennsylvania State University under contract with the Eastern Regional Research Center, Philadelphia, PA, developed several new processed lamb meat items that utilize the nonprimal cuts. For various reasons, most of the new items never reached commercial status.

Recently, ARS agricultural economist Howard W. Kerr, Jr., of the Agribusiness Program (Federal Building, Hyattsville, MD 20782) in cooperation with industry and taking advantage of knowledge gained in the Penn State developments, selected six new types of lamb meat items for commercial demonstration. All six items utilized nonprimal cuts of lamb meat. The new frozen lamb meat products were made available to about 100 of the country's leading institutional volume food outlets. The items were: sectioned and formed lamb patties, sausage and roast; shanks in barbeque sauce; cubes; and curry. Based on an analysis of resulting opinions and suggestions, the new products were modified, some redesigned, others dropped.

Next came flaked and formed lamb steaks and sticks—breaded and unbreaded. By flaking the nonprimal lamb meat, a homogenous consistency was obtained; thus, the end products were of uniform texture, color, and quality. Forming, on the other hand, insured individual items of uniform size. This step permitted exact portion control; a "must" in today's highly competitive market. While the work with institutional users was underway, some of the Nation's major meat processors became interested and geared their research efforts to similar products.

In late 1975, a purveyor who annually markets more than 30 percent of the domestic lamb supply formally presented flaked and formed lamb steak to the Armed Forces Products Evaluation Committee. The committee evaluated and accepted the product and specifications are being written for future purchases by the Armed Forces. Moreover, the new products are now commercially available in some areas of the country. Purveyors report institutional acceptance as excellent and growing.

As more consumers become aware of the new lamb products, demand for them is expected to grow. Ultimately, this increased demand will benefit American sheep and lamb ranchers. Increased demand will also encourage more farm production, thereby bringing even more lamb to market. Hopefully, the long-term decline in the Nation's per capita consumption of lamb may be reversed.—*H. W. K.*

***Below:*** *Cooperating University of Arizona agronomist Fred Arle sprays cotton plants with growth regulators (0176X21–8A).* ***Right:*** *A bisected cotton boll reveals pink bollworm larvae. After feeding on late-season bolls, pink bollworm larvae pupate either in the boll or in the ground after dropping from the boll (0176X22–22).* ***Far right:*** *Dr. Kittock checks late-season bolls in an untreated control plot.*

# New weapon in the cottonfield

COTTON PLANTS are more or less blooming idiots. They form squares, flowers, and bolls throughout the growing season until stopped by a killing frost in the fall.

That little bit of biological activity may give scientists—and hopefully cotton farmers—a means of limiting the life cycle of the pink bollworm, one of the more destructive pests of cotton in the Southwest.

The pink bollworm overwinters as diapausing (hibernating) larvae in the soil after developing in the late-season fruiting parts, the bolls, of the cotton plant.

To combat this pest, ARS scientists at the Western Cotton Research Laboratory (4207 East Broadway Road, Phoenix, AZ 85040) have developed a technique for limiting the number of overwintering pink bollworms by reducing their food supply late in the year. They employ growth regulators to prevent formation of new bolls late in the season. The growth regulators do not, however, affect the development of existing bolls or vegetation. Since most of the late-season bolls do not mature, the effect on lint yield is minimal.

In combination with other control methods, chemical termination of late-season bolls shows a high potential for reducing pink bollworm populations to manageable levels. The technique also has possibilities, with modifications, for control of other diapausing cotton insects, such as the boll weevil, that have no important alternate hosts.

Field tests in Arizona and California show that chemical termination has resulted in a 95-percent reduction of green bolls at harvest without affecting yield and quality, and a 90-percent reduction of diapausing larvae in the soil.

Pink bollworm larvae, after feeding on the late-blooming bolls, drop to the soil and hibernate during the winter. In the spring they pupate, emerge as adults, and lay eggs on the early blooms of cotton. Eggs hatch and the almost invisible larvae bore into early cotton bolls, feed, go through several instar stages or molting periods, bore their way out, and drop to the ground. During the growing season they pupate and emerge as adults in a few days and start the cycle over again. It is only in the winter that they go into diapause because their food supply would be gone should they emerge after a cotton-killing freeze. Several generations during the year build bollworm populations to astronomical numbers if no control is used.

Present control of pink bollworm is in the use of insecticides. About 50 percent of all insecticides used in U.S. agriculture are used on cotton. A large per-

*No hiding place for pink bollworms here. Dr. Kittock inspects a test plot that had been treated with a growth regulator to prevent formation of late-season bolls (0176X19–31).*

centage of this insecticide use is for control of pink bollworm and boll weevil—$50 to $75 million annually. Further, loss to growers through boll and square damage by pink bollworm and boll weevil amounts to $130 to $230 million each year. To complicate matters, insecticides applied to control the pink bollworm and the boll weevil destroy predators of other insect pests of cotton, leaving the cotton more vulnerable to their attack.

During a normal year, cotton farmers may apply pesticides about 15 times at a cost, each time, of from $5 to $7 per acre.

Termination of late-fruiting cotton could delay the first application until buildup of the pink bollworm population to damaging levels, some 30 to 60 days. Such a delay in insecticide application could save farmers $2 to $4 million per year. If similar results should be obtained with boll weevils, the total yearly savings to growers are estimated at $100 to $200 million.

Agronomists David L. Kittock and H. Fred Arle (formerly of ARS, now at the University of Arizona) and entomologist Louis A. Bariola report that "such savings would make the U.S. cotton grower more competitive on the world market and more competitive with synthetic fibers on the U.S. market.

"This would have important implications to the U.S. balance of payments and less dependency on the use of petroleum products for synthetic fibers, insecticides and solvents for insecticides."

The Arizona scientists have developed three formulations, after testing some 30 to 35, that appear adequate to do the job. Applications are made near the end of August with harvest scheduled about November 1.

The three formulations in order of preference, are:

- 2,4-D and CCC—(2-chloroethyl) trimethyl ammonium chloride. Cost of 2,4-D is about 3 to 5 cents per acre while CCC costs about $1 in Europe where it is used widely on small grains. CCC cost is higher in the United States.
- 2,4-D and chlorflurenol. The cost of the latter almost rules it out at present as a growth regulator on cotton.
- 2,4-D alone.

The combination of MCPA and CCC stunts the plants at the top, and while they can make flowers, they are unable to set bolls. Formulations with CCC or chlorflurenol carry the plants through the season.

Cultural practices that might be used along with chemical termination in controlling the bollworm include early shredding of stalks, early and deep tillage, and winter irrigation that "drowns" diapausing larvae.

The research on growth regulators is being conducted in cooperation with the Arizona Agricultural Experiment Station.—*J. P. D.*

# STREAMBANK STABILIZATION WITH WILLOWS

WILLOWS may one day wave in the wind over what are now erosion-devastated streambanks.

A long-term study was begun in June 1974, by ARS research hydraulic engineers Andrew J. Bowie and Calvin K. Mutchler of the Sedimentation Laboratory (P.O. Box 1157 Oxford, MS 38655) and Kenneth R. Blan, Eugene D. Taylor, and Calvin McElreath of USDA's Soil Conservation Service. It will evaluate the effectiveness of three species of willow trees in stabilizing eroded streambanks, a serious problem throughout the country.

Streambank erosion causes multiple problems, among them the loss of valuable soil, flooding, and the silting of river and stream channels, lakes, and reservoirs. Sediment, in fact, is the most serious pollutant of waterways. There are about 150,000 miles of badly eroded streambanks in the country today.

The site of the present study is on Pigeon Roost Creek in northwestern Mississippi, a creek typical of many miles of eroded streambanks in the United States. Approximately 117 square miles of drainage area lie above the location.

Willows were chosen for the test because vegetation for streambank stabilization must grow in the continuously wet soil at the toe of the streambank slope as well as in the dryer soil farther up the slope. Besides surviving under such conditions, the trees must withstand the powerful rush of water when the creek is flowing high, and hold the soil against it. Observations of willows growing under natural conditions indicate that they might be ideal for streambank stabilization. The researchers are using native black, Halberd, and MS 878 willows for the experiment.

A number of measurements will be taken continually during the study to record soil loss, water velocity, willow survival, and other variables. The scientists will also record the progress of the experiment by photographs.

Willow cuttings three-eighths to one-half of an inch in diameter and 8 to 10 inches long are being planted 5 inches deep on both sides of a total of 1,500 feet of streambank in three locations on the creek. They are being planted on a slight slant downstream to prevent debris from lodging in the tops of the cuttings until growth has been established. The willows will be fertilized to accelerate growth and establishment.

Along with observation of their soil holding properties, the willows will also be watched to see if they have a potential for spreading from the planting sites and becoming pests. If they show that they could become pests, for instance by moving into the channels of the streams or into adjacent farmland, the study will determine how they might be managed.

In a related but different study, the researchers will plant Halifax maidencane rhizomes at the toe of the slope at another location on Pigeon Roost Creek to determine whether this plant can survive and control streambank erosion.

*—B. D. C.*

# WOOD: Ally in war on pests

*Research chemist Rosalind Y. Wong and Dr. Jurd examine a model of the molecular structure of the naturally occurring larvicide—obtusaquinone—as determined by X-ray crystalography (1075X2085–3).*

TIMBERS which are naturally resistant to decay or insect attack are now providing valuable clues for chemists searching for new types of pesticides and insect repellants.

Chemist Leonard Jurd and his colleagues, Gary D. Manners and Kenneth L. Stevens, also chemists at the Western Regional Research Center (800 Buchanan Street, Berkeley, CA 94710) suggest that pesticides which contain only carbon, hydrogen, and oxygen, and have molecular structures similar to pesticides that occur naturally in plants, may be less broadly toxic, less persistent, and more biodegradable than some of the synthetic compounds in current use. These scientists have isolated and identified microbicidal chemical substances from several plant species. They are now modifying the structures of these natural microbicides to yield compounds that may be useful in control-

***Near right:*** *Larvicides are removed from their native wood by continuous hot solvent extraction. Dr. Stevens secures the base of the extractor after filling it with sawdust. The extractor has a capacity of 5 to 10 pounds. Depending on the wood being used, it extracts approximately 10 percent of the weight of the wood (1075X2086–5).*

***Center:*** *Before naturally occurring larvicides can be extracted, the wood in which they exist must be reduced to powder. To achieve this, Dr. Manners pours woodchips into a hammer mill (1075X2085–14).*

ling insect pests.

A good example of this approach to development of less hazardous pesticides stems from recent work on the chemistry of Indian species of the *Dalbergia* genus. These timbers contain a unique series of cinnamylphenols that have not been found in any other plant genus.

ARS microbiologist A. D. King and Dr. Jurd have shown that these phenols—particularly one known as obtusastyrene—are potent bactericides, fungicides, and algicides. They are relatively ineffective against higher organisms. However, the effects of these natural phenols can be drastically altered by slight structural changes to give compounds that are effective sterilants, growth inhibitors, or repellents for specific insect pests.

Many of the modified natural phenols have been tested by ARS as mosquito larvicides or growth inhibitors, and as housefly chemosterilants at the Insects Affecting Man Research Laboratory, Gainesville, Fla. A simple dialkyl derivative of obtusastyrene proved to be a highly active growth inhibitor for the malaria mosquito (*Anopheles quadrimaculatus*). At concentration of 0.15 parts per million, it prevents development of more than 90 percent of the mosquito larvae.

When incorporated into fly food, this same compound is as effective as the standard azaridine chemosterilant, tepa, in sterilizing houseflies. A related benzylphenol appears to be even more effective than tepa. At concentrations only one-fifth of those of tepa in fly food, it causes 100 percent sterilization of flies.

Some of these compounds also show much promise as repellents for the confused flour beetle (*Tribolium confusum*), one of the most widespread and injurious insect pests of cereal products. Tests by ARS entomologist Hagen B. Gillenwater, Stored-Product Insects Research and Development Laboratory, Savannah, GA, have demonstrated that four of Dr. Jurd's relatively simple benzylphenols show a very high degree of persistent repellency. Over a 2-month testing period they consistently repelled a higher percentage of the insects, their effectiveness being from 42 to 50 percent greater than that of the standard pyrethrin repellent.

The diverse biological activity of natural cinnamylphenols has been further demonstrated in a cooperative project with Dr. J. D. Bultman of the Naval Research Laboratory, Washington, DC. The Navy had long been interested in determining the chemical agent responsible for the unusually high resistance of a Panamanian tree, *Dalbergia retusa*, to attack by marine organisms. Dr. Jurd's group established that the constitutents of this wood are similar to those of the different Indian *Dalbergia* species.

Using data from nuclear magnetic resonance spectra and X-ray crystallography, the natural larvicide was identified as an orange colored quinone, formed in the plant by oxidation of a cinnamylphenol. This quinone, and chemicals created in the laboratory that are similar to it, is highly toxic to marine borers and to termites. Borer attack on susceptible pine is inhibited by impregnating the wood with this natural quinone which may serve as a model for the development of new types of wood preservations.—*D. H. S.*

*Dr. Manners prepares to fractionate the crude extract of* Dalbergia retusa, *a resistant Panamanian hardwood tree, by column chromotography on silicic acid (1075X2084–6A).*

# Pruning pears with shakers

FOUR YEARS of pruning pear trees with mechanical harvesting equipment in Michigan orchards shows fruit size is up and pruning costs are down.

Preliminary tests were made with several cooperating pear growers by ARS agricultural engineers Bernard R. Tennes and Jordan H. Levin, and plant pathologist Clyde L. Burton (Agricultural Engineering Building, Michigan State University, East Lansing, MI 48823).

The project was initiated by growers and ARS researchers because mechanical harvesters were shaking down too much wood and trash along with the fruit.

Because of the shape of pear trees and the difficulty of finding labor to prune trees, growers have tended to let pruning go, thereby producing the fall-out problem at harvest time.

By using the harvesting equipment to prune wood in the late winter and early spring, Dr. Tennes says 6 to 17 pounds of wood can be removed from each tree. Cost is approximately 50 cents per tree compared to about $2.50 for normal pruning procedures.

Tests were made with different shaking times and at different temperatures. The amount of material removed increased with temperature. For example, more wood was removed at 38° F than at 10° F. However, pruning should be done during the dormant period.

Though more research is needed, Dr. Tennes says results so far indicate that pears and in substantially lower pruning costs. Trees shake-pruned apparently were invigorated, based upon observation of regrowth the first year after shaking.

Dr. Tennes warns that further testing must be conducted under commercial conditions and in several different areas before large-scale pruning is done by shaking.—*R. G. P.*

# Fiber in bread

FIBER-ENRICHED BREAD could be produced to help meet a need, suggested in some medical studies, for increased fiber in Western diets.

Higher incidence of coronary heart disease, diabetes, and some colon diseases in Western countries is linked by certain medical researchers with low-fiber content of diets. If such a relationship exists, occurrence of the diseases might be reduced by increasing dietary fiber.

ARS chemist Y. Pomeranz found that acceptable bread can be produced when up to 7 percent of the wheat flour is replaced with microcrystalline celluloses or wheat bran. More than 7 percent cellulose impaired loaf volume and other functional breadmaking properties.

Dr. Pomeranz, cereal research technologist Merle D. Shogren, and chemists Karl F. Finney and Donald B. Bechtel evaluated nonnutritive celluloses, wheat bran, and oat hulls as fiber additives. The celluloses are manufactured for use in pharmaceutical products and as fillers in fabricated foods.

None of the additives that the four researchers evaluated at the U.S. Grain Marketing Research Center (1515 College Avenue, Manhattan, KS 66502) proved to be ideally suited to breadmaking.

Inclusion of 7 percent celluloses had little effect on taste, color, or texture of bread. But bread containing higher levels of celluloses probably would be more expensive to produce because of lengthened mixing time, and is likely to have more than the 38 percent water content now permitted. Bran had little effect on mixing time, moderately increased water absorption, and modified taste and color of bread. Oat hulls were unsuitable as a fiber additive because they gave the bread an objectionable gritty texture.—*W. W. M.*

# AGRISEARCH NOTES

## Resistance to downy mildew

RESISTANCE to downy mildew has been added to a new parental line for producing hybrid sunflowers of the large-seeded confectionary type.

The fertility restorer line RHA 293, released by ARS and North Dakota State University, Fargo, is the first large-seeded restorer line with resistance to the disease. Downy mildew is the most serious sunflower disease in the Red River Valley of North Dakota and Minnesota. Management practices may restrict soil and seed transmission of the fungus *Plasmopara halstedii*, which causes downy mildew, but may not prevent spread of windborne spores.

RHA 293 is susceptible to rust, another important disease in all sunflower-growing area. ARS researchers Gerhardt N. Fick and David E. Zimmer (206 Waldron Hall, N.D.S.U., Fargo, ND 58102) point out, however, that hybrids produced with RHA 293 and rust-resistant female lines are resistant to both downy mildrew and rust.

ARS and North Dakota State have also released an improved female parent for hybrid confectionary sunflowers. The line, designated HA 292, is highly resistant to rust and has improved seed shape, size, and color over previously released female lines. It has an extremely vigorous plant type that should contribute to high seed yields in hybrids.

The first rust-resistant parental lines for producing hybrid confectionary sunflowers were released in 1973 by ARS, North Dakota State, and Texas A. & M. University, College Station. In tests, the best hybrids produced with these lines, have yielded about 20 percent more seed than the rust-resistant variety Sundak, introduced in 1972, and nearly double the yields of rust-susceptible varieties grown earlier under rusted conditions.—*W. W. M.*

## Solar drying and double cropping

HARVESTING winter wheat 3 to 7 days earlier than normal and drying it with solar-warmed air in conventional grain bins may be a way for farmers who plan double cropping of wheat and soybeans to get the soybeans planted early.

In the Midwest, yields and profits from the double-cropping system depend critically on timing of the wheat harvest and soybean planting, says ARS agricultural engineer John R. Barrett, Jr. (Agr. Engr. Bldg., Purdue University, West Lafayette, IN 47906).

In solar-drying studies that he conducted in cooperation with the Purdue University Agricultural Experiment Station, 1,600 bushels of wheat dried down from 18 to 23 percent moisture to 13 to 14 percent in 2 weeks that included bright, hot days with low humidity in early July. "Even if weather had been less ideal than it was in this first year of study, we believe the drying could have been accomplished in 3 weeks at most," says Mr. Barrett.

The researchers used solar-warmed air from an inflated plastic collector. The heated air was fan-blown into bins of wheat. Purdue engineers had used the same equipment in corn drying experiments.

The solar-dried wheat had test weights averaging 61 pounds per bushel compared to 58 pounds for field-dried wheat, said Mr. Barrett. Quality of the solar-dried wheat was higher, he says, and harvest losses were reduced.—*G. B. H.*

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## Finding a worthy successor

SURVIVAL is the name of the game for every living species, and natural selection makes the rules.

When scientists discover a chemical that wipes out vast numbers of insects, natural selection provides those that survive with resistance. The survivors pass their resistance on to succeeding generations, and after a while scientists are confronted with a strain of insect created by the chemical that once controlled it.

Scientists must then find another chemical that will do the job until the process is repeated.

Malathion, a chemical that has given very good protection to stored rice for 20 years, is losing its effectiveness. A strain of Angoumois grain moth, a serious pest of stored rice, has emerged that is highly resistant to malathion—so much so that the chemical offers no protection against it.

But in their dialectical struggle with the insect world, scientists have the advantage of knowing the rules and thus preparing moves in advance. Having anticipated the decline of malathion, scientists have sought an effective chemical with which to replace it (AGR. RES., March, 1976, p. 15).

Tests by ARS entomologist Robert R. Cogburn, Stored-Rice Insects Laboratory (Box 784, Beaumont, TX 77706) indicate that such a chemical has been found for stored rice. The chemical tested, pirimiphos methyl, gave very effective control of the malathion-resistant strain of Angoumois grain moth for 12 months at a rate of 15 parts per million (ppm). The malathion treatment at a rate of 14 ppm failed totally to control this strain of the pest. Mr. Cogburn believes that pirimiphos methyl will probably give as good control as did malathion when it was first used two decades ago.

Related studies by Mr. Cogburn have shown that, without protection, stored rice can suffer losses of up to 20 percent from insect infestations. This would amount to millions of dollars lost yearly in the United States, and hundreds of millions worldwide.

The test involved subjecting good, clean, "Labelle" rough rice in 114 liter fiberboard drums to a continuous and heavy population of several species of insects simultaneously. The attack was started and kept up by periodically placing insects around the edge of the room containing the drums of rice. Samples of rice were taken at intervals throughout the test to monitor insect populations as well as chemical residues and rice quality.

Mr. Cogburn concluded at the end of the year-long test that pirimiphos methyl at both 10 and 15 ppm promises excellent protection for stored rice. It is now time to conduct field tests under actual commercial storage conditions.

The Environmental Protection Agency has been petitioned to grant a label for the use of pirimiphos methyl on stored rice, but it has not yet been registered for this use.—*B. D. C.*

*—B. D. C.*

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

PROTECT
Use Pesticides Safely
FOLLOW THE LABEL



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